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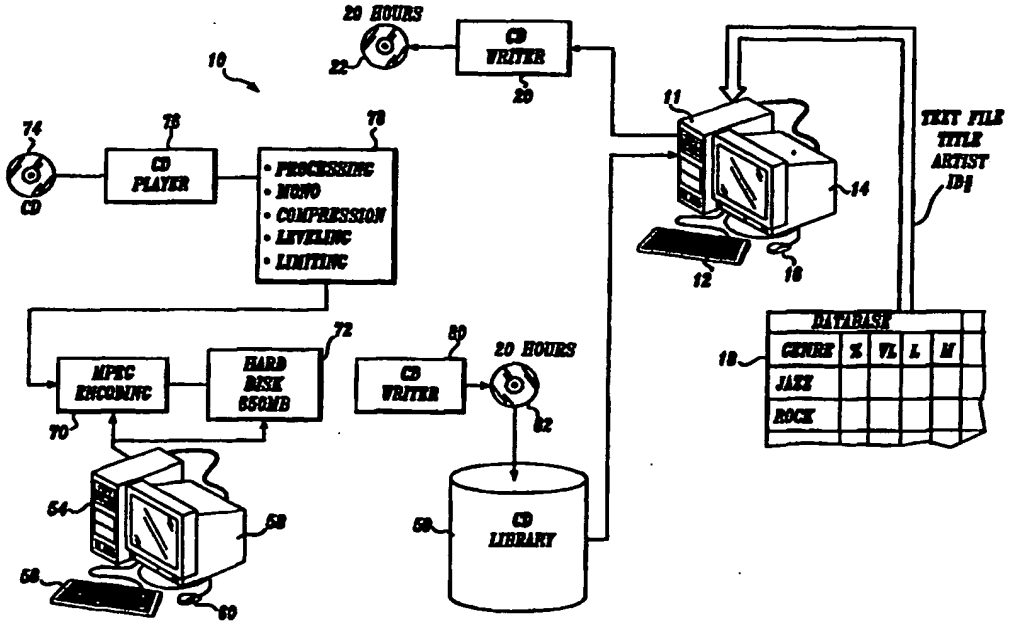

(57) Abstract

A system for creating customized CD-ROMs of compressed audio data. A computer system includes a database of music that is categroized by a plurality of factors. A user selects which factor they require and the computer system selects songs meeting the criteria selected. The selected songs are compressed and stored as files on a CD-ROM. A CD-ROM player including a computer and an MPEG decoder plays the compressed audio files. The CD-ROM has instructions encoded thereon that define the order of the songs to be played and the length of time for which a group of songs will be played.

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CUSTOMIZED MUSIC DISTRIBUTION AND PLAYBACK SYSTEM

Field of the Invention

The present invention relates to audio systems in general and, in particular, to background music audio systems.

Background of the Invention

In virtually every retail and consumer establishment, it is common to find background music systems. To provide the musical content for such systems, it has generally been necessary to purchase a special receiver that receives satellite broadcasts of the background music. Alternatively, it had been necessary to subscribe to a service that provides customized recordings of background music. Both solutions have inherent problems.

When a user subscribes to a broadcast music distribution service, they are forced to play the music that is selected by the broadcaster. Although a user may sign up to receive broadcasts of a specific genre of music, such as all classical or jazz, etc., the user has little say in the particular musical selections that will be played. In many retail or office environments, the particular music to be played is carefully selected based on a variety of factors such as style, beat, ethnic origin, etc. With the broadcast music service, the user cannot guarantee that music meeting their requirements will always be played.

For users who sign up to receive customized recordings of various music styles, the selection of the background music can be more specifically tailored to a particular environment. Such customized recordings are typically made in real time. That is, it takes a technician four hours to record four hours worth of music. Therefore, such customized recordings are prohibitively expensive for most users.

These customized recordings are generally delivered to the user on audio tapes or Compact Discs. This limits the amount of music that can be stored on a single recording. Therefore, the user must continually monitor the operation of the background music system and rotate the recordings in order to avoid playing the same musical selections over and over. In addition, if the user wants to control the time at which particular musical selections are played, he or she must manually adjust the operation of the player at the desired time.

Given the shortcomings in the prior art, there is a need for a music playback system that provides the benefits of a customized music recording and long play time without repeats. In addition, there is a need for a music playback system that can automatically control when audio selections are played to eliminate the need for on-site user programming.

Summary of the Invention

The present invention is a music playback system whereby a user can create a customized CD-ROM recording of a variety of musical selections. The user interacts with a computer database that categorizes music by a number of attributes including genre, style, beats per minute, etc. The user selects attributes of music they would like to record and the computer searches the database for music that matches the selected attributes. Music matching the selected attributes is divided into one or more groupings or "programs." Each program can be instructed to play continually or sequentially. The musical selections that comprise each program can be played sequentially or randomly and each program can be assigned a maximum length of play. In addition, commercials or announcements can be inserted into the programs.

To increase the amount of audio data that can be stored on a single CD-ROM, the present invention stores the data in a compressed format. The currently preferred format is MPEG I, Level 2 that was developed by the Motion Pictures Exchange Group for the storage and transmission of audio and video data. A single CD-ROM created according to the present invention can store up to 18 hours of music quality audio data.

In addition to storing the compressed audio data, the CD-ROM also stores a computer program that operates a CD-ROM player as well as a playlist. The playlist provides data about the CD-ROM and defines the number of programs on the CD-ROM. A definition of each program is also stored on the CD-ROM. The program definition includes an identification number of the program, a program title, a

playtype either continuous or sequential, a maximum play time, and a list of audio files that comprise the program.

To play the CD-ROM, a CD-ROM player is provided. The CD-ROM player is designed around a standard IBM-compatible computer including CD-ROM reader and an MPEG decoder. Files of compressed MPEG data are read by the computer, stored in its memory, and sent to the MPEG decoder as specified by the program definitions.

Brief Description of the Drawings

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a block diagram of a system for creating customized CD-ROMs of compressed audio data according to the present invention;

FIGURE 2 illustrates the data that are stored on the CD-ROM;

FIGURE 3 is a block diagram of a compressed audio CD-ROM player according to the present invention; and

FIGURES 4A–4B are a series of flow charts showing the operation of the CD-ROM player according to the present invention.

Detailed Description of the Preferred Embodiment

To compensate for shortcomings in the prior art background music playback systems, the present invention is a system for creating customized CD-ROMs containing up to 18 hours of compressed audio data and a player that can decompress and play such audio data.

As discussed above, in many retail and customer environments, the music to be provided for the customers or clients is carefully selected. Such selections are based on a variety of factors including the music's genre, such as jazz or rock, as well as style within a given genre, such as Dixieland jazz, acid jazz, swing jazz, etc. Musical selections may be further selected within a given style by the gender of the artist, number of musicians, beats per minute, etc. To provide a user with a customized recording of songs matching one or more particular musical styles in which they are interested, the present invention comprises a computerized system for creating recordings of compressed audio data.

As shown in FIGURE 1, the present invention is a system 10 that allows a user to select styles of music in which they are interested and to record songs meeting

the user's criteria onto a CD-ROM. A computer system 11 of the type including a conventional keyboard 12, monitor 14, and pointing device 16 such as a mouse, runs a database or spreadsheet program that allows a user to select a variety of musical attributes. The database or spreadsheet program 18 categorizes a library of prerecorded songs by these attributes including artist name (lead), artist's names (supporting), year (song written), year (song recorded), year (album), artist nationality (lead), instrumentation (supporting), instrumentation (lead), solo (instrument/s), music genre (21 total options), music style(s) (256 total options), beats per minute, energy level (5 total options), record company, performance company (ASCAP, BMI, SESAC, etc.), publisher, instrumental/vocal, artist gender (lead), artist gender (supporting), charts (position reached on charts "Billboard"), weeks on charts. The user interacts with the database program by selecting the attributes they want for their music.

The attributes selected are made on a program-by-program basis, wherein a program is a group of songs that meet the criteria selected. For example, a user may want a program to contain 25% rock music and 75% jazz, wherein the jazz category is further broken down into 50% Dixieland, 25% fusion, 10% swing, and 15% acid jazz. The acid jazz category can be further broken down quite specifically to only include, for example, songs that have a fast beat and high energy, that were recorded by female artists. Finally, the user selects a maximum play time for the program, whether the program is to be continuously played and whether the songs that comprise the program are to be played sequentially or in a random order.

In the presently preferred embodiment of the invention, a user can have up to four programs per recording. The total play time for all the programs cannot exceed the capacity of the CD-ROM, which is currently about 18 hours. For the purposes of the present application, the term "song" is meant to include music both with and without lyrics. In addition to music, the user can also record advertisements or announcements in a program.

After the user has selected what type of music is to be recorded in each program, the computer system 11 generates a list of songs including a unique identification number that identifies a computer file containing a compressed recording of the song, the title, and the artist of a song that match the user's selected criteria. Using the identification number of each song specified in the list, the computer system 11 recalls a compressed recording of the song from a CD-ROM library 50 and records the song on a CD-ROM 22 using a CD-ROM writer 20. Once

the criteria of the music to be played have been selected, it is possible to create a CD-ROM containing 18 hours of recorded music in approximately seven minutes.

In a conventional Compact Disc, the amount of real time audio data that can be stored thereon is limited to approximately 74 minutes. In order to increase the amount of data that can be stored on a single recording, the present invention stores the audio data as a compressed file that is preferably encoded using an MPEG I, Level 2 format. In an MPEG compression system, a string of real time digitized audio data is compressed by converting the string into one or more binary "packets" that represents an input into a mathematical equation. When an MPEG decoder is provided with a packet, it computes the mathematical equation to recreate the original string of digitized audio data. Because the binary "packets" contain less binary digits than the original string of audio data, the amount of audio data that can be stored by recording the packets versus the original uncompressed, audio data is greatly increased.

To compress a song, the system 10 also includes an encoding station that comprises a computer system 54 having a conventional keyboard 56, monitor 58, and pointing device such as a mouse 60. The computer system 54 interfaces with and operates an analog-to-digital converter/MPEG encoder 70 model number SX-23e produced by Antex Corporation of Sunnyvale, California, and a hard disk drive 72. A song to be compressed is retrieved from an uncompressed Compact Disc 74, which is played in a conventional Compact Disc player 76. The output of the Compact Disc player 76 is fed into a number of audio processors 78 including a summing network such as a mixer that converts the analog stereo/audio signal into a monophonic signal. In addition, the monophonic signal is limited, to remove musical spikes that exceed a predetermined threshold and is compressed and leveled to increase the audio power of the soft passages and decrease the audio power of the loud passages. As an alternative to the Compact Disc player 76, audio data, such as commercials or announcements may be recorded on audio tape and played by a tape player.

After processing, the processed audio data is applied to an input of the MPEG encoder 70. The MPEG encoder 70 samples the processed monophonic audio signal at approximately 48,000 samples/second. Each sample consists of 16 bits of data for a total of 768,000 bits of data for a second of audio. The MPEG encoder compresses this data to 80,000 bits per second for a compression ratio of 9.6:1.

The compressed audio data are written as a .WAV file on the hard disk drive 72. The .WAV file format is specified by the Microsoft Corporation for

audio/video files and is considered well-known to those of ordinary skill in the art. In addition, the title of the song, the artist, the copyright licensor and all the musical attributes of a song described above are written to the database 18. When the hard disk is full, it is connected to a CD-ROM writer 80 that transfers the .WAV files onto a CD-ROM 82. The CD-ROM 82 is then placed in the CD-ROM library 50 where it can be accessed by the computer system 11 in order to create a customized, compressed CD-ROM 22 for a particular user. It should be appreciated that not all the data for a song stored in the CD-ROM library are transferred to the CD-ROM 22 that is created for a user. For example, the length of a song and the copyright licensor are not recorded. This information is only used by the computer system 11 to calculate how many songs can be recorded and to make sure the appropriate royalties are paid.

FIGURE 2 illustrates the data that is recorded on the CD-ROM 22. At the beginning of the CD-ROM is a file that contains a computer program 90 that operates a CD-ROM player that plays the CD-ROM. Following the computer program 90 is a playlist 92 that identifies the version number of the program, an identification number of the CD-ROM, a title of the CD-ROM, the number of programs stored on the CD-ROM (presently between one and four), and the number of compressed music/audio files that are stored on the CD-ROM.

Following the playlist is a number of program files 94 that describe each program stored on the CD-ROM. Each program file includes an identification number, a title of the program, a play type (either continuous or sequential), the song play type (either continuous or random), the maximum play time of the program and a list of songs that are included in the program, including the artist and title information, as well as identification number of the compressed audio file that contains the song. Following the program files 94 are a series of compressed audio files 96.

As will be described in further detail below, by recording the playlist and the description of each program, the CD-ROM player can play one or more programs on the CD-ROM in a desired order without human intervention or on-site programming of the CD-ROM player.

FIGURE 3 is a block diagram of a CD-ROM player that plays the compressed audio files described above. The CD-ROM player 110 generally comprises an Intel 386, IBM-compatible computer 112, a CD-ROM reader 116, a number of switches 118, a display 119 and an MPEG decoder/digital-to-analog converter 122. The switches 118 are connected to either the computer's interrupt lines or I/O port so

that a user can enter commands which alter the program operation of the computer 112. The display 119 is provided as a means for allowing the computer to display information for the user.

The CD-ROM player 116 reads the compressed audio CD-ROM to be played and transfers the data to the computer's memory. To decode the compressed audio data, the MPEG decoder 122 comprises an SX-5e MPEG player also available from Antex Corporation. Data is transferred from the computer's memory to the MPEG decoder on a data bus 124. A series of control/interrupt lines 126 allow the computer 112 to control the operation of the MPEG decoder 122 and vice versa.

The operation of the computer 112 to decode the compressed audio data is set forth in the flow charts shown in FIGURES 4A–4B. As indicated above, the computer program that operates the computer 112 is contained on the CD-ROM that is inserted into the CD-ROM reader 116. Upon startup, the computer 112 reads the program from the CD-ROM reader 116 and stores the program in its internal memory. Execution of the program then begins in order to play the compressed audio data.

As shown in FIGURE 4A, the first step performed by the computer unit is to initialize the display 119 and the MPEG decoder 122 at a step 150. At a step 152, it is determined whether an error occurred during the initialization step. If yes, then the program is immediately halted. Assuming that no error occurred during the initialization, the computer reads a play list from the compressed audio CD-ROM. As described above, the play list comprises a series of data including the version number of the program being operated, an ID number of the CD-ROM, a title of the CD-ROM, the number of audio programs stored on the CD-ROM, the number of compressed audio files that are stored on the CD-ROM. At a step 156, it is determined whether an error occurred in reading the play list from the CD-ROM. If so, the program exits at a step 158.

Assuming no error occurred during the reading of the play list, the computer begins a loop that plays all the programs in the order specified by the program descriptions contained on the compressed audio CD-ROM. At a step 160, the computer calls a play program subroutine, described below, that plays the first program on the CD-ROM. At a step 162, it is determined whether any errors occurred during the playing of the first program. If not, the description of the next program description is read from the CD-ROM at a step 164, and processing returns to step 160 to play the next program. This process continues until every program on

the CD-ROM has been played or an error occurs, in which case processing jumps to a step 166 whereby the CD-ROM player is shut down and processing halts at a step 168.

The steps performed by the computer in the play program subroutine are shown in FIGURE 4B. Beginning with a step 180, the computer analyzes the program definition including an identification number of the program, a title of the program, the program play type (either continuous or sequential), the maximum play time of the program (in minutes), the song play type (either sequential or random), and the list of audio files to be played including the identification number that identifies the corresponding compressed audio file, the title, and artist. In addition, a timer within the computer system that marks the playing time of the program is started.

Once the computer has read the list of audio files that are to be played in the program, a particular audio file is read from the CD-ROM at a step 182. At a step 184, the audio file is transferred to the MPEG decoder that begins decompressing the file and converting the digitized audio to an analog signal that is fed to an amplification system and speakers. At a step 186, the computer determines whether an audio file is playing. If so, the computer checks the status of the switches 118 that are connected to the computer. Any commands entered by the switches are then processed at a step 190. Processing then returns to step 186, until the audio file is finished playing.

Once the audio file is finished playing, the computer determines whether all songs in a program have been played at a step 192. If so, the computer determines whether the program play type is continuous at a step 194. If so, processing then returns to step 180 and the program is played again. If the program play type is not continuous, then processing proceeds to a step 196 that returns to step 160 shown in FIGURE 4A, so that the next program on the CD-ROM can be played.

If the answer to step 192 is no, and not all audio files that comprise the program have been played, the computer then determines whether the maximum play time of the program has been exceeded at step 197. To do this, the computer reads the timer that was started at step 180 when the program was started. This timer records the total length of time that a particular program has been playing. For example, a particular program may contain only 90 minutes of recorded music and commercials/announcements. A user can repeat the audio files recorded for this program for four hours by setting the play type of the program to continuous and

setting the maximum play time to four hours. The computer system will continue to play the audio files in the program until the maximum play time is exceeded.

If the maximum play time is exceeded at step 197, then processing proceeds to step 196 and the next program will begin. If the answer to step 197 is no, and the maximum play time was not exceeded, the ID number of the next audio file in the program is obtained at a step 198 and processing returns to step 182 wherein the corresponding compressed audio file is read from the CD-ROM before being delivered to the MPEG decoder.

As can be seen from the above description, the present invention allows a user to create customizable, long-play recordings of songs and commercials/announcements that meet particular criteria. Because the CD-ROM contains a description of the order in which the programs are to be played and the length of each program, the user does not have to continuously monitor the operation of the background music system or program a player.

While the present invention has been described with respect to its preferred embodiments, those skilled in the art will recognize that changes may be made to the invention without departing from the spirit and scope thereof. For example, although the present invention currently utilizes CD-ROMs to carry the encoded MPEG data, other means such as digital audio tape could also be used. In addition, each program could be made to begin playing at a specified time by including a start time in the program description. The computer would be programmed to compare the time of an internal clock to the start time set forth on the CD-ROM and begin playing the program at the appropriate time. Of course, the user would need to set the clock contained in the computer to the correct time using the switches 118 shown in FIGURE 3.

Another advantage of the present invention is that the computer system can play any program or specific audio file on command. For example, the computer within the CD-ROM player can be interfaced with a fire alarm system so that in the event of a fire, a program containing the audio files with emergency instructions are played. It is therefore intended that the scope of the invention be determined solely from the following claims and the equivalents thereto.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A system for creating customized audio recordings, including:

a computer system that classifies a library of prerecorded, compressed audio files by a number of criteria that can be selected by a user,

a computer program running on the computer system that lets a user select the criteria of the audio data to be recorded, wherein the computer program searches a database for audio files that match the selected criteria;

a CD-ROM writer coupled to the computer system for transferring prerecorded compressed audio files matching the song files selected by the computer system to a CD-ROM, the computer system also placing on the CD-ROM a description of an order in which the compressed audio files are to be played; and

a CD-ROM player that receives the CD-ROM and decompresses the audio files in the order described on the CD-ROM.

2. The system for creating customized audio recordings, according to Claim 1, wherein the compressed audio files on the CD-ROM are arranged in one or more programs, each program including one or more compressed audio files, wherein the description of the order in which the audio files are to be played includes a description of the order in which the one or more programs are to be played.

3. The system for creating customized audio recordings, according to Claim 2, wherein the description of the order in which the audio files are to be played includes an indication of a maximum length of time for which the audio files for a program are to be played.

4. The system for creating customized audio recordings according to Claim 3, wherein the CD-ROM player comprises a CD-ROM reader, a computer and a decoder for decoding the compressed audio files, the computer including a timer that is started when a program in the CD-ROM begins playing and wherein the computer plays audio files in a programs repeatedly until the maximum length of time for which the audio files for a program are to be played is exceeded.

5. The system for creating customized audio recordings, according to Claim 2, wherein the description of the order in which the audio files are to be played

includes an indication of whether the audio files in a program are to be played sequentially or randomly.

6. The system for creating customized audio recordings, according to Claim 2, wherein the description of the order in which the audio files are to be played includes an indication of whether the audio files in a program are to be played continuously.

7. The system for creating customized audio recordings according to Claim 1, further comprising:

a system for creating the compressed audio files including:

means for playing a stereophonic audio recording;

processing means for converting the stereophonic audio recording into a monophonic audio recording, for leveling and limiting the monophonic audio recording;

an analog to digital converter for sampling the processed, monophonic audio recording; and

a compressor for compressing the sampled processed, monophonic audio recording.

8. The system for creating customized audio recordings according to Claim 7, wherein the compressor comprises an MPEG encoder.

9. A compressed audio disk player, comprising:

a CD-ROM having a number of compressed audio files stored thereon, the CD-ROM also including a time at which an audio file is to be played;

a CD-ROM player that reads the compressed audio files from the CD-ROM and decompresses the audio files;

a computer system that controls the CD-ROM player, the computer system including a clock circuit that provides a current time, the computer system being programmed to compare the current time with a time specified on the CD-ROM in order to actuate the CD-ROM player to play an audio file at the time specified.

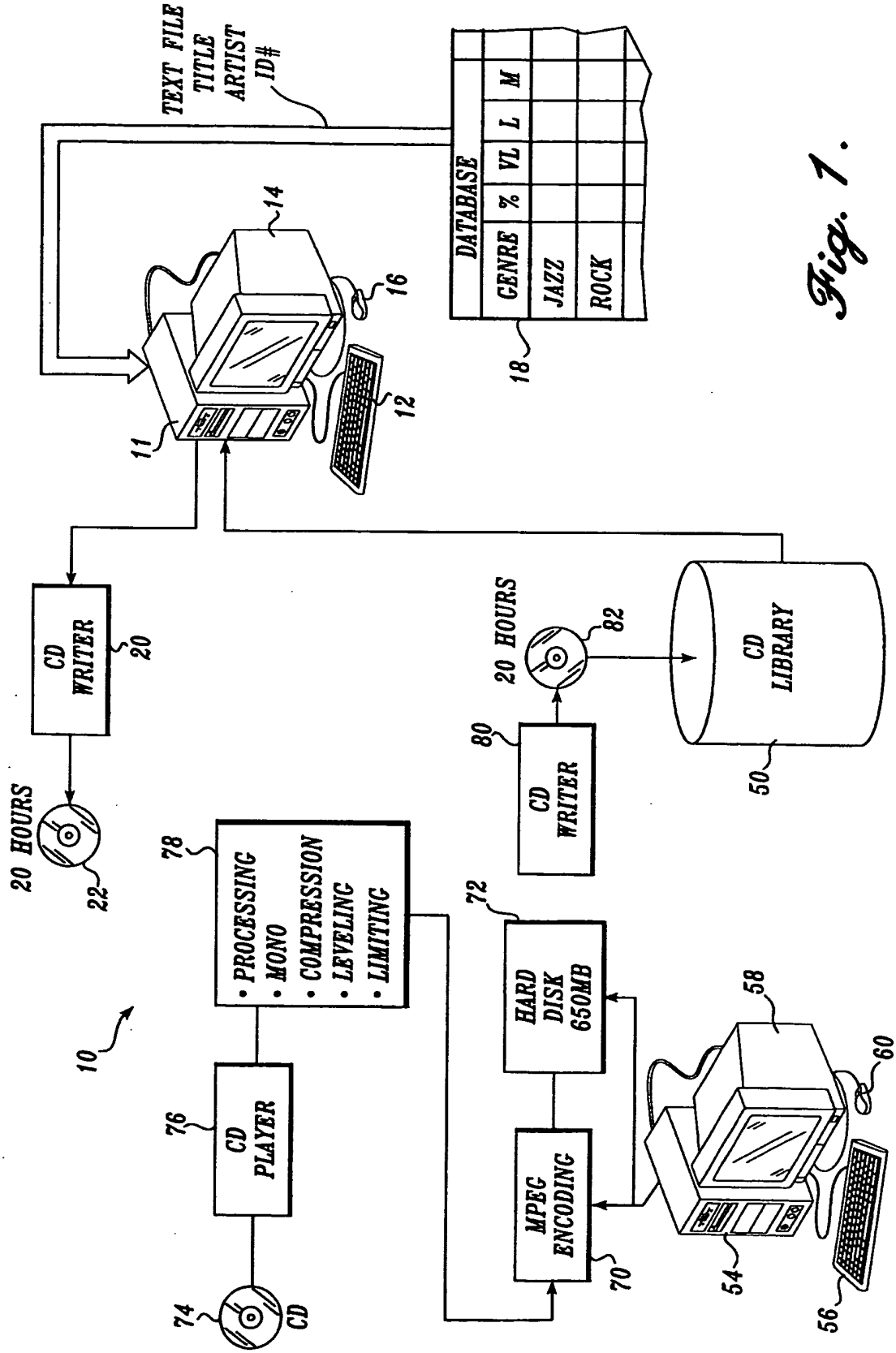
10. The compressed audio disk player of Claim 9, wherein the compressed audio files are arranged into one or more programs each of which includes one or

more compressed audio files, the CD-ROM also including a description of an order in which the audio files in a program are to be played.

11. The compressed audio disk player of Claim 9, wherein the compressed audio files are arranged into one or more programs each of which includes one or more compressed audio files, the CD-ROM also including a description of an order in which the audio files in a program are to be played.

12. The compressed audio disk player of Claim 10, wherein the CD-ROM includes a maximum time for which the audio files in program are to be played.

13. The compressed audio disk player of Claim 10, wherein the CD-ROM includes an indication of whether the audio files in a program are to be played continuously.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TITLE
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ROCK
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14
16
12
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CD WRITER
20
20 HOURS
22
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20 HOURS
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CD LIBRARY
50
78
• PROCESSING
• MONO
• COMPRESSION
• LEVELING
• LIMITING
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60
10
76
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MPEG ENCODING
70
54
56
74
CD

Fig. 1.

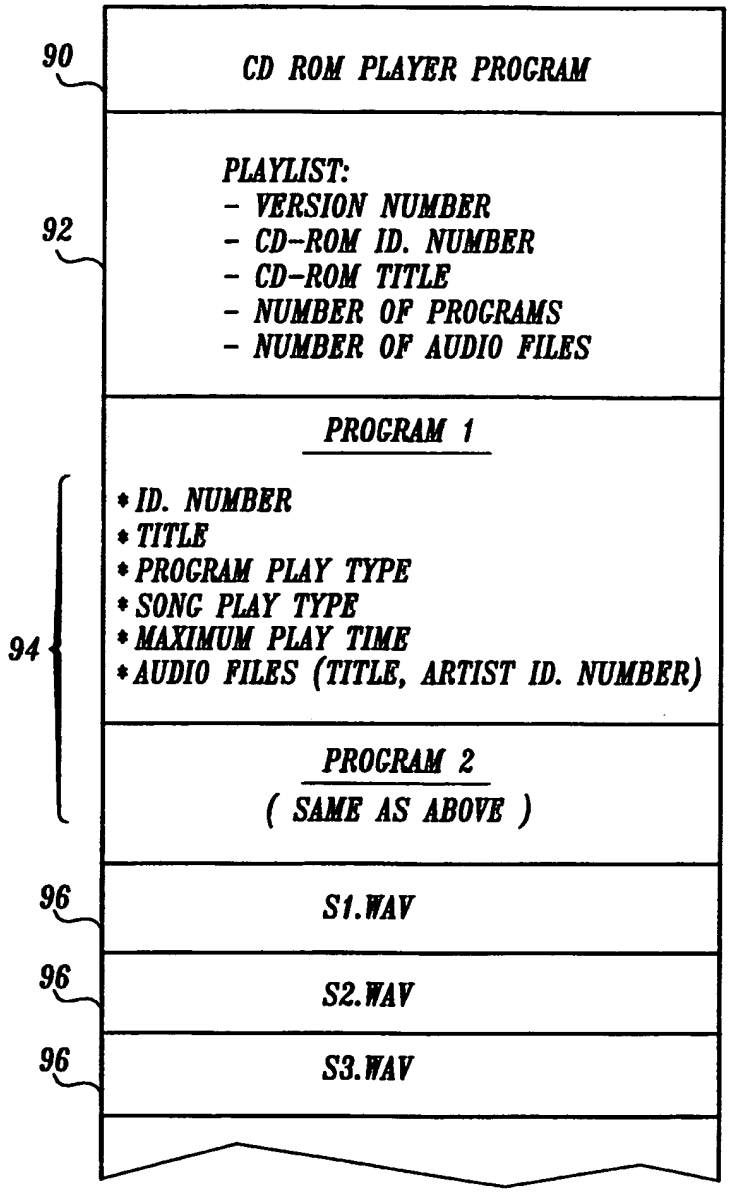

90
CD ROM PLAYER PROGRAM
92
PLAYLIST:
- VERSION NUMBER
- CD-ROM ID. NUMBER
- CD-ROM TITLE
- NUMBER OF PROGRAMS
- NUMBER OF AUDIO FILES
PROGRAM 1
94
* ID. NUMBER
* TITLE
* PROGRAM PLAY TYPE
* SONG PLAY TYPE
* MAXIMUM PLAY TIME
* AUDIO FILES (TITLE, ARTIST ID. NUMBER)
PROGRAM 2
(SAME AS ABOVE)
96
S1.WAV
96
S2.WAV
96
S3.WAV

Fig. 2.

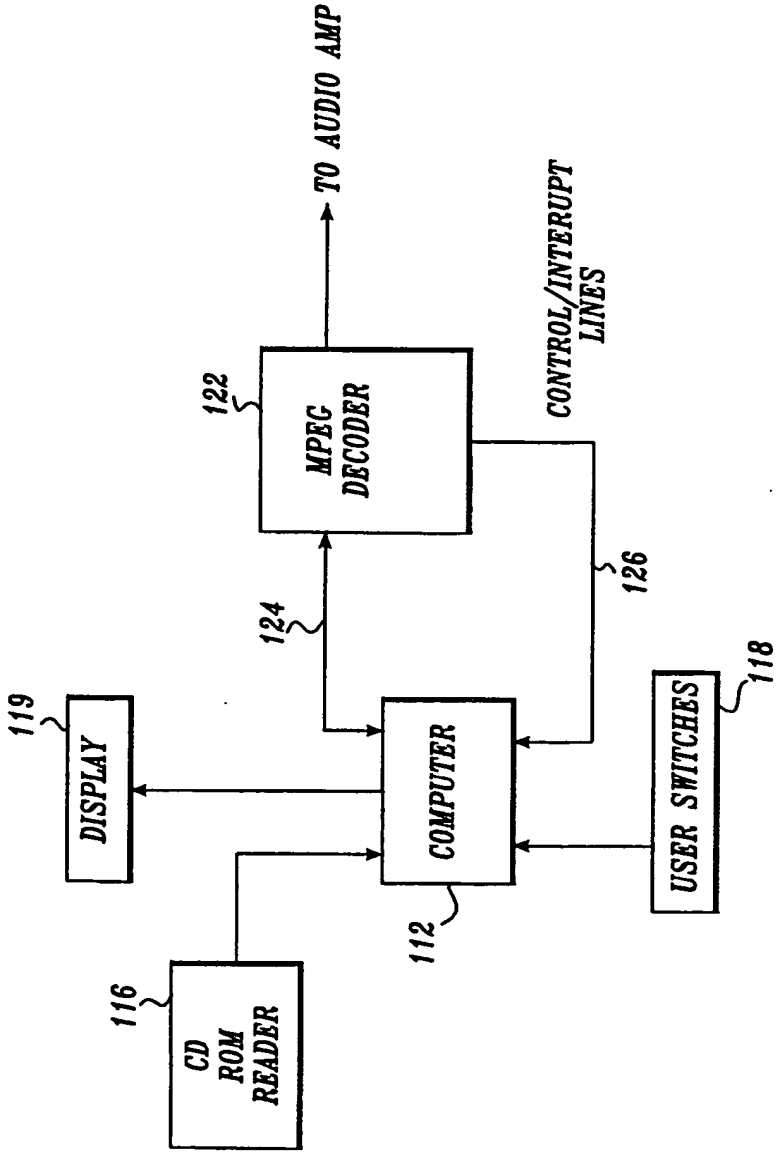
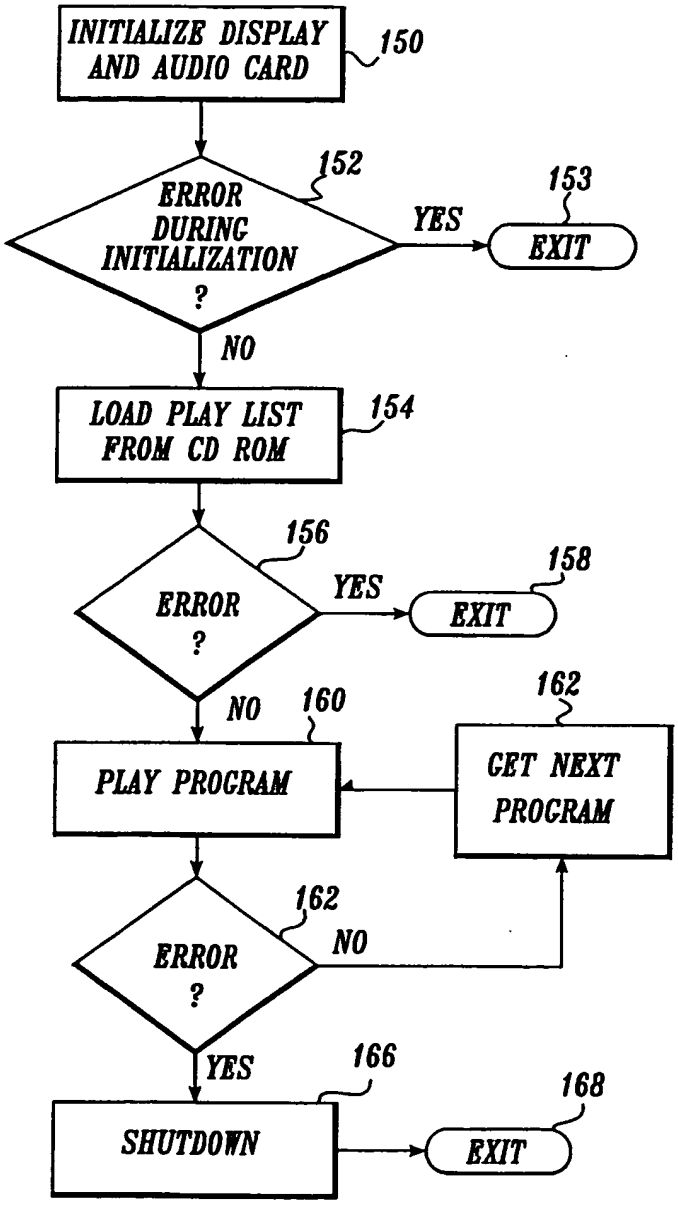

TO AUDIO AMP
CONTROL/INTERUPT LINES
122
MPEG DECODER
126
124
119
DISPLAY
COMPUTER
USER SWITCHES
118
112
116
CD ROM READER

Fig. 3.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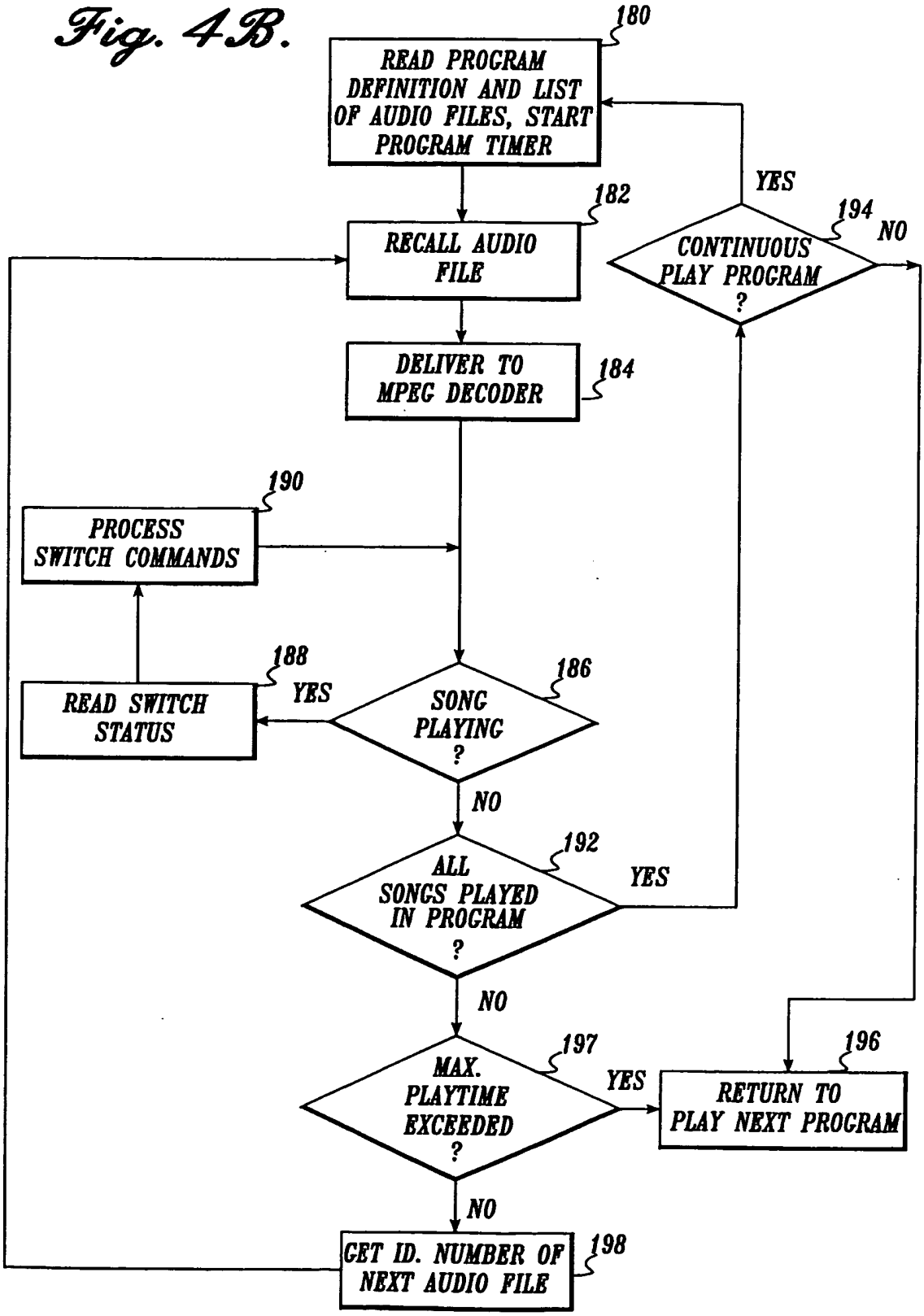
150
ERROR DURING INITIALIZATION ?
152
YES
153
EXIT
NO
LOAD PLAY LIST FROM CD ROM
154
ERROR ?
156
YES
158
EXIT
NO
160
PLAY PROGRAM
162
GET NEXT PROGRAM
ERROR ?
162
NO
YES
166
SHUTDOWN
168
EXIT

Fig. 4A.

Fig. 4B.


180
READ PROGRAM DEFINITION AND LIST OF AUDIO FILES, START PROGRAM TIMER
182
RECALL AUDIO FILE
DELIVER TO MPEG DECODER
184
190
PROCESS SWITCH COMMANDS
188
READ SWITCH STATUS
YES
186
SONG PLAYING ?
NO
192
ALL SONGS PLAYED IN PROGRAM ?
YES
NO
197
MAX. PLAYTIME EXCEEDED ?
YES
196
RETURN TO PLAY NEXT PROGRAM
NO
GET ID. NUMBER OF NEXT AUDIO FILE
198
YES
194
CONTINUOUS PLAY PROGRAM ?
NO

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